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or from buildings should likewise be regarded with suspicion. Other things being equal, places having a water supply from artesian or deep-driven wells should be given the preference. Unscreened toilets, because of the flies which they breed, and because of the chance which these insects have to pick up the germs of typhoid fever therein and carry them to the boarder's food, are particularly dangerous. It is equally important, both for the comfort and the health of the guest, that the house also be screened.

It has been shown in the foregoing paragraphs how the fly may carry the germs of typhoid fever from the toilet to the kitchen and there infect the food which people eat. There is another way in which it may infect food, and this is particularly important from the standpoint of the child. The source of the milk supply should always be investigated in choosing a place of summer residence, and if it is found, as is too frequently the case, to be from dirty, fly-infested stables, in which dirty cows are milked by dirty hands, it is best to give the place a wide berth.

Another insect to be avoided is the mosquito. It used to be thought that malaria was caused by night air, but nowadays it is known that the only bad thing about night air is the mosquito which it contains. This insect infects people with malaria by biting them and injecting the germ as it bites. Therefore when a place of summer residence is chosen it should not be an unscreened house, nor should it be in a swampy region, nor in a locality in which there are small pools of water well adapted to the breeding of mosquitoes.

Finally, if there is any doubt in the mind of the summer tourist let him consult the local health officer of the locality under consideration.

REPORT ON AN OUTBREAK OF TYPHOID FEVER AT LINCOLN, NEBR., IN 1911.

By L. L. Lumsden, Passed Assistant Surgeon, Public Health and Marine-Hospital Service.

On the request of the governor of Nebraska the writer was detailed by the Surgeon General of the Public Health and Marine-Hospital Service to proceed to Lincoln, Nebr., and to make an investigation of an outbreak of typhoid fever in that city, with a view to determining the sources of the infection and the measures necessary for the control of the disease.

The investigation was begun on November 4 and terminated on November 17, 1911. It comprised an epidemiological study of cases reported from July 1 to November 1, a sanitary survey of the city and its immediate environs, bacteriological examinations of the water supply, and inspections of dairies and other places where foods were sold or prepared for sale.

In conducting the investigation the writer had the active cooperation of Dr. H. W. Waite, professor of bacteriology and pathology in the University of Nebraska, who was engaged by the city council to assist in the investigation; the city health officer; the city engineer; and the water commissioner. The bacteriological examinations were made in the bacteriological laboratory of the University of Nebraska. The media used in the examination of the water supply were prepared with especial care by Mr. John J. Putnam, technical assistant in the laboratory.

TIME OF OCCURRENCE AND EXTENT OF OUTBREAK.

In the four months, July, August, September, and October, 1911, 161 cases were reported in the city. Of these 141 were investigated. No definite information was obtainable in about 20 of the reported cases, but during the course of the investigation of the reported cases 9 others were learned of and investigated, making a total of 150 cases investigated. Of these 150 cases 6 were in persons who had become infected while away from Lincoln, leaving 144 for detailed consideration.

The occurrence of the cases, according to dates of definite onset of symptoms, is shown in the following table:

Dates of onset of symptoms.

Day of month.	June.	July.	August.	Sep-tember.	Octo-ber.	Day of month.	June.	July.	August.	Sep-tember.	Octo-ber.
1.....		1	1	3	1	18.....		1	3		
2.....				1		19.....			4	1	1
3.....				3		20.....		2	6		
4.....		1	3	4		21.....			2	2	
5.....				1		22.....			3		
6.....				1		23.....			6	1	1
7.....		1				24.....			9		
8.....					1	25.....		1	7		
9.....		1	2			26.....		1	4	2	
10.....			3	1		27.....			3		
11.....			3	3		28.....	1		6		1
12.....			3		1	29.....		1	6	1	1
13.....						30.....		2			
14.....			4	1		31.....		1	1		
15.....		1	8	2		Total....	1	16	93	27	7
16.....		1	3								
17.....		1	3								

CHART, I.

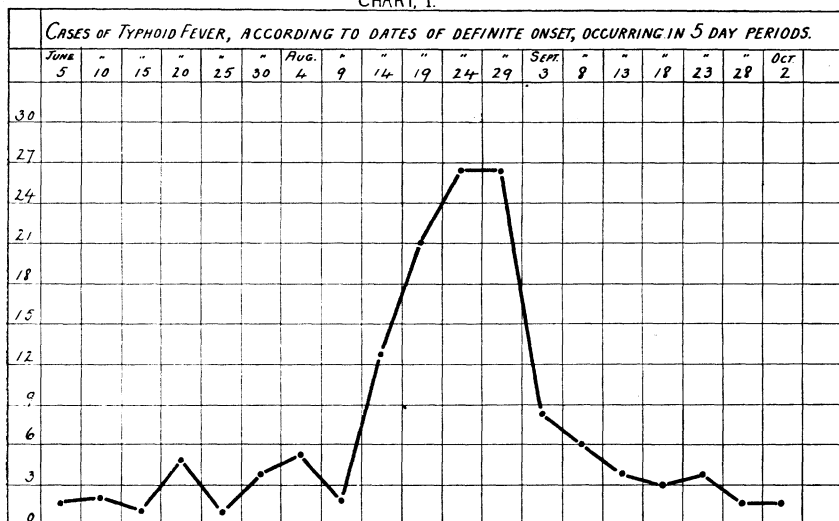


Chart 1 shows the chronological progress of the disease according to occurrence of cases in five-day periods. The curve shows a sharp rise for August. Prior to July, 1911, reporting of cases of typhoid fever

in Lincoln was not required, and consequently a comparison of the number of cases reported in 1911 with the numbers for previous years can not be given.

On the evening of November 6 a public meeting was held under the auspices of the city council for the purpose of discussing the typhoid-fever situation. Some of the physicians present expressed the opinion that typhoid had been no more prevalent in the city during the summer of 1911 than in the several previous summers. Others were of the contrary opinion.

There was an agreement among the majority of the physicians and others at the meeting that the disease had been unusually prevalent in the northeast section of the city during the summer of 1911.

The following table gives the number of deaths from typhoid fever, by months, recorded at the city health office from January 1, 1890, to November 1, 1911:

Reported deaths from typhoid fever, by months, from Jan. 1, 1890, to Nov. 1, 1911.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1890....	1	.....	.....	4	1	.....	.....	1	3	4	6	3	23
1891....	1	.....	.....	3	2	.....	1	.....	1	2	2	3	15
1892....	.....	.....	1	.....	1	1	.....	1	3	2	7	4	20
1893....	2	2	.....	.....	1	2	.....	3	2	7	4	4	27
1894....	1	1	.....	.....	1	1	2	2	3	1	3	.....	15
1895....	1	1	2	.....	.....	.....	.....	3	3	7	2	.....	19
1896....	.....	.....	1	1	1	1	.....	1	1	2	1	3	12
1897....	.....	.....	.....	2	.....	1	1	2	2	.....	1	1	10
1898....	.....	1	1	1	.....	1	2	.....	4	2	1	.....	13
1899....	1	.....	1	.....	.....	.....	.....	2	1	3	1	2	11
1900....	.....	.....	.....	1	1	.....	.....	.....	2	.....	.....	.....	4
1901....	1	1	.....	.....	.....	2	1	1	4	2	2	.....	14
1902....	.....	1	.....	1	.....	.....	.....	5	2	4	.....	2	15
1903....	.....	.....	.....	.....	.....	1	1	1	2	.....	2	.....	7
1904....	1	.....	.....	.....	.....	.....	.....	.....	2	1	5	.....	9
1905....	.....	.....	.....	.....	.....	.....	.....	1	5	2	1	.....	9
1906....	.....	.....	.....	1	1	1	.....	.....	3	.....	.....	3	9
1907....	1	.....	.....	.....	.....	1	.....	4	4	1	1	1	13
1908....	1	.....	.....	.....	.....	1	1	1	1	.....	.....	.....	5
1909....	.....	.....	2	.....	.....	.....	.....	1	.....	.....	1	.....	4
1910....	.....	.....	.....	.....	.....	.....	.....	2	3	1	.....	1	8
1911....	.....	1	.....	.....	.....	1	.....	2	4	1	.....	.....	9

Judging by the face of the death returns, the disease for the city as a whole did not seem to be much, if any, more prevalent in the summer of 1911 than it had been in that season of a number of previous years. Thus, at the outset there seemed to be some uncertainty as to whether there had been in the summer of 1911 an unusual prevalence or an outbreak of the disease.

GEOGRAPHICAL DISTRIBUTION.

Upon investigating the cases it was determined that the disease had been much more prevalent in the section of the city north of J Street and east of Fourteenth Street than in other sections of the city. That section contains about one-fourth of the city's population and furnished about 84 per cent of all the cases reported and investigated which occurred in July, August, September, and October, 1911. Of the 23 cases occurring in persons who lived outside the especially affected section, 11 were in persons who, during the 30 days prior to illness, had gone into the affected section from time to time and

drunk water from the taps while there. In the especially affected section the general sanitary conditions were better than those for some of the other sections of the city and somewhat better than those for the average section of the city.

AGE DISTRIBUTION.

The persons affected were according to age and sex as follows:

Age and sex of patient,

Age in years.	Male.	Female.	Total.	Age in years.	Male.	Female.	Total.
0 to 4.....				40 to 44.....	3	4	7
5 to 9.....	9	9	18	45 to 49.....		3	3
10 to 14.....	4	5	9	50 to 54.....	1	2	3
15 to 19.....	15	14	29	55 to 59.....	1	1	2
20 to 24.....	16	16	32	60 to 64.....			
25 to 29.....	8	11	19	65 to 69.....	1		1
30 to 34.....	8	6	14				
35 to 39.....	6	1	7	Total.....	72	72	144

The disease appeared to be distributed generally throughout the population in the affected section without any strikingly disproportionate number of cases in either one of the sexes or in any particular age groups. The age distribution was not suggestive of a milk outbreak.

POSSIBLE SOURCES OF THE INFECTION RESPONSIBLE FOR THE OUTBREAK.

The season of occurrence of the outbreak suggested the possibility of flies, personal contact, milk, ice cream, green vegetables, fruits, and other foods having been important factors in the spread of the infection. The epidemiological evidence collected strongly suggested that some of these were operative to some extent, but pointed beyond reasonable doubt to the conclusion that some factor other than these had been predominant in the distribution of the infection.

Flies were no more abundant and their chances to spread infection from human excreta to foods appeared to be no greater in the section especially affected than in other sections of the city. Eight per cent of the cases investigated were reasonably attributable to infection through contact with previous cases, but the hypothesis that personal contact was the predominant factor would not be reconcilable with the geographical distribution of the disease.

There was no disproportionately large number of cases among the customers of any of the dairymen, the number of cases along the different milk routes in the affected section being roughly proportionate to the amount of milk distributed. The larger milk dealers among whose customers any considerable number of cases occurred distributed milk also in sections of the city in which the disease was not unusually prevalent. By similar tokens ice cream, vegetables, fruits, and baking products were eliminated as predominant factors. It was suggested by some of the citizens that many of the cases had been caused by infection contracted at camp-meeting grounds and summer resorts outside but near the city, but the investigation de-

terminated that about 50 per cent of the cases were in persons who during the 30 days immediately before onset of illness had not been to such places nor elsewhere outside the city limits.

WATER.

The epidemiological data pointed definitely to the city water supply as the principal source of the infection responsible for the outbreak.

There are some private wells in use, but the vast bulk of the water used in the city is obtained from the public supply. The sources of water used for drinking during the 30 days prior to illness by the persons affected are given in the following table:

Source of drinking water of patients during 30 days prior to illness.

Water used for drinking.	Number of cases developing in—			
	July.	August.	September.	October.
Raw city:				
Solely.....	8	70	19	2
Principally.....	5	19	4	4
Occasionally.....	3	3	4	1
Total.....	16	92	27	7
Boiled city:				
Solely.....				
Principally.....		1		1
Occasionally.....				
Total.....		1		1
Private wells:				
Solely.....				
Principally.....	3	3	4	
Occasionally.....		8	3	1
Total.....	3	11	7	1
Out of town:				
Solely.....				
Principally.....				
Occasionally.....	6	12	3	3
Total.....	6	12	3	3
Total cases investigated.....	16	93	27	7

The public water supply was obtained from three artesian wells, known as the A Street well, the F Street well, and the Rice well. These wells furnished about 3,274,000 gallons of water per day. The largest source of supply was the A Street well, which furnished about 100,000 gallons per hour. The F Street well furnished about 33,000 gallons per hour, and the Rice well about 30,000 gallons per hour.

During the spring and summer of 1911 the pump at the Rice well was run on an average of about 20 hours per day, that at the F Street well about 6 or 8 hours per day, and that at the A Street well 24 hours per day. When the F Street and the Rice well pumps were not running, the mains in the sections receiving water from these two wells would be supplied entirely with water from the A Street well. Thus the water from the A Street well was distributed over the entire city, but the distribution of water from the Rice well was largely confined

to the section of the city north of J Street and east of Fourteenth Street, and the distribution from the F Street well was largely confined to the section north of J Street and west of Fourteenth Street. The distribution of the typhoid outbreak corresponded very strikingly with the distribution of water from the Rice well. This fact, along with the evidence obtained by the epidemiological investigation of cases, pointed strongly to the Rice well as the source of infection.

Bacteriological examinations were made of samples of water from each of the three wells and from taps and fire hydrants in different parts of the city. The results of the examinations are presented in the following table:

Results of examinations of city water.

Source.	Date of examination.	Number of bacteria per c. c., as determined by colonies on agar plates after 48 hours' incubation at 37° C.	Gas in lactose bouillon from—		B. coli in—	
			1 c. c.	10 c. c.	1 c. c.	10 c. c.
Rice well:						
Sample No.—						
1.....	Nov. 6	1	—	—	—	—
2.....	Nov. 7	1	—	—	—	—
3.....	Nov. 8	33	—	—	—	—
4.....	Nov. 9	3	—	—	—	—
5.....	Nov. 10	0	—	—	—	—
6.....	Nov. 11	0	—	—	—	—
7.....	Nov. 13	1	—	—	—	—
Average.....		5				
Percentage positive.....			0	0	0	0
F Street well:						
Sample No.—						
1.....	Nov. 8	2	—	—	—	—
2.....	Nov. 9	0	—	—	—	—
3.....	Nov. 10	0	—	—	—	—
4.....	Nov. 11	1	—	—	—	—
Average.....		0.7				
Percentage positive.....			0	0	0	0
A Street well:						
Sample No.—						
1.....	Nov. 9	0	—	—	—	—
2.....	Nov. 10	5	—	+	—	+
3.....	Nov. 11	6	—	+	—	+
4.....	Nov. 13	4	—	—	—	—
5.....	Nov. 14	8	—	+	—	+
6.....	do.....	3	—	—	—	—
Average.....		4				
Percentage positive.....			0	50	0	50
House tap at—						
2332 N Street 1.....	Nov. 6	2	—	—	—	—
2332 N Street 2.....	do.....	0	—	—	—	—
2400 N Street 1.....	do.....		—	—	—	—
2400 N Street 2.....	do.....		—	—	—	—
2314 Randolph Street.....	do.....		—	+	—	+
2540 Randolph Street.....	do.....		—	+	—	+
744 South Twenty-eighth Street.....	do.....		—	+	—	+
305 South Twenty-seventh Street.....	do.....		+	+	+	+
338 South Twenty-seventh Street.....	do.....		—	+	—	+
2138 G Street.....	do.....		—	+	—	+
2725 Randolph Street.....	do.....		+	+	+	+
Fourteenth and G Streets.....	Nov. 7	4	—	+	—	+
2228 Q Street.....	do.....	2	—	—	—	—
1645 G Street.....	do.....		—	+	—	+
2032 N Street.....	do.....		—	+	—	+
307 South Fourteenth Street.....	do.....		—	—	—	—
1802 N Street.....	do.....		—	—	—	—
2232 O Street.....	do.....		—	—	—	—
2541 N Street.....	do.....		—	—	—	—
2636 Q Street.....	do.....		—	+	—	+
2524 O Street.....	do.....		—	—	—	—

¹ Sample taken after pump at Rice well had been stopped for several hours.

² Sample taken a few minutes after starting pump at Rice well.

Results of examinations of city water—Continued.

Source.	Date of examination.	Number of bacteria per c. c., as determined by colonies on agar plates after 48 hours' incubation at 37° C.	Gas in lactose bouillon from—		B. coli in—	
			1 c. c.	10 c. c.	1 c. c.	10 c. c.
House tap at—Continued.						
2400 N Street.....	Nov. 7	—	—	—	—	—
2330 P Street.....	do.	—	—	—	—	—
Fourteenth and K Streets.....	do.	—	—	—	—	—
330 North Fourteenth Street.....	do.	—	+	—	—	+
2127 N Street.....	do.	—	—	—	—	—
1400 O Street.....	do.	—	—	—	—	—
2208 P Street.....	do.	—	—	—	—	—
2322 N Street.....	do.	—	—	—	—	—
1624 Vine Street.....	Nov. 8	—	—	—	—	—
2213 Vine Street.....	do.	520	—	+	—	—
1903 Vine Street.....	do.	—	+	+	+	+
512 North Twenty-sixth Street.....	do.	—	—	+	—	—
633 North Twenty-sixth Street.....	do.	—	—	—	—	—
2420 Vine Street.....	do.	—	+	+	+	+
333 North Twenty-fourth Street.....	do.	—	—	—	—	—
226 North Twenty-fourth Street.....	do.	—	—	—	—	—
816 H Street.....	Nov. 10	—	—	+	—	+
628 South Twelfth Street.....	do.	—	—	—	—	—
615 G Street.....	do.	—	—	—	—	—
1204 G Street.....	do.	1	—	—	—	—
1144 E Street.....	do.	—	—	+	—	+
2741 Randolph Street.....	Nov. 11	1	—	+	—	+
2703 Randolph Street.....	do.	3	—	—	—	—
2534 Randolph Street.....	do.	0	—	—	—	—
State University.....	Nov. 12	—	—	+	—	+
Do.....	do.	—	—	—	—	—
821 South Fourteenth Street.....	Nov. 13	2	—	+	—	+
1900 J Street.....	do.	—	—	—	—	—
1441 Rose Street.....	do.	2	—	—	—	—
1620 South Twenty-third Street.....	do.	2	—	—	—	—
930 South Fourteenth Street.....	do.	3	—	+	—	+
728 South Fourteenth Street.....	do.	1	—	+	—	+
148 South Twenty-seventh Street.....	do.	—	—	—	—	—
1444 A Street.....	do.	2	—	+	—	+
2540 Randolph Street.....	do.	4	—	—	—	—
2120 Sumner Street.....	do.	4	—	—	—	—
325 South Twenty-seventh Street.....	do.	2	—	—	—	—
1429 South Fourteenth Street.....	do.	—	—	—	—	—
1927 J Street.....	do.	1	—	—	—	—
State University.....	do.	2	—	—	—	—
1920 J Street.....	Nov. 14	1	—	+	—	+
1936 J Street.....	do.	2	—	—	—	—
State University.....	do.	1	—	—	—	—
Do.....	Nov. 15	4	—	+	—	—
Average.....		21	—	—	—	—
Percentage, positive.....			6	40	6	35
Fire hydrant at—						
Ninth and H Streets.....	Nov. 9	—	—	—	—	—
Twenty-fourth and J Streets.....	do.	—	—	—	—	—
Thirtieth and Potter Streets.....	do.	—	+	+	+	+
Eleventh and K Streets.....	do.	—	+	—	—	—
Eleventh and A Streets.....	do.	—	—	+	—	+
Thirtieth and Oak Streets.....	do.	—	+	+	+	+
Twenty-fifth and L Streets.....	do.	—	—	+	—	+
Twenty-second and W Streets.....	do.	—	+	+	+	+
Seventeenth and C Streets.....	do.	—	—	+	—	+
Twenty-second and Q Streets.....	do.	—	—	—	—	—
Twenty-second and T Streets.....	do.	—	+	+	+	+
Twenty-third and F Streets.....	do.	—	+	+	+	+
Twenty-second and Dudley Streets.....	do.	—	+	+	+	+
Positive, percentage.....			46	69	46	75

The examinations of the water from the Rice well and the F Street well gave no evidence whatever of contamination of these two sources. The examinations of the water from the A Street well and from the taps and hydrants, however, gave evidence of contamination. The

colon bacillus content of the water from the A Street well and the taps when considered along with the low total bacterial content strongly suggested pollution with sewage.

The fact that gas-forming organisms were more abundant in the samples of water collected from the fire hydrants than in those from the taps probably was due largely to the leaky condition of the fire hydrants distal to the valves, permitting dirt to enter the hydrants and to be washed through when the water was turned on.

Extreme care was exercised in collecting the samples to preclude the likelihood of accidental contamination. The mouths of the taps and hydrants were flamed with an alcohol lamp and the water was permitted to run for 5 to 10 minutes before the samples were taken.

The results of the examinations of the water from the Rice and the F Street wells were in accord with those obtained by Dr. Waite in his examinations of five samples of water from the Rice well and three from the F Street well during the month immediately preceding the beginning of the investigations by the writer.

Contamination of the A Street well could not have been responsible for the typhoid outbreak, as was shown by the lack of relation between the distribution of the water from that well and the distribution of the disease.

Water of the character which was shown consistently during the period of the investigation by that of the Rice well could not be reasonably implicated as an important source of typhoid infection. Therefore it appeared certain that if contamination of the Rice well had been responsible for the typhoid outbreak such contamination had ceased to occur before the beginning of the investigation.

Consideration was given to the possibility of the outbreak having been caused by contamination of the water in the city mains after the water had left the wells. In a number of places water mains and sewers were close together. In one or two places where the water main and sewer lay close together slight leaks in both water main and sewer had been found. Some of the citizens stated that at times during the month prior to the outbreak there had been practically no pressure in the taps in the basements of houses in the affected section, but both the city engineer and city water commissioner stated that in their opinion the pressure in the mains in no section of the city had been so low that there would have been a likelihood of seepage into the mains through leaks in the pipes.

A water main was found to pass through a sewer well at Nineteenth and J Streets. Sewage flowed over this water main. There was a slight leak in the joint of the main which was fixed in the cement on the edge of the semicylindrical sewer. When the sewage rose in the well, as it was liable to do in times of heavy rains, there was certainly a chance for sewage to enter the water main at this point, provided the pressure within the main was not greater than that outside the main.

Samples of water for bacteriological examination were taken from many different taps with a view particularly to determining at what points, if any, there was pollution of the water as it coursed through the mains, but with negative results. All evidence of contamination found in the water taken from the taps could be attributed, for the most part certainly, to the contamination of the water of the A Street well. Therefore it appeared that if contamination of the water as it

coursed through the mains had been responsible for the typhoid outbreak such contamination had ceased to occur.

According to all information obtained from the city officials there had been done since the period of causation of the outbreak no work on the wells, water mains, or sewers which could have been reasonably expected to have changed the situation.

All three of the wells which were in use are of the same general type. The Rice well has been in use for over 20 years. It is about 60 feet in depth and about 24 feet in diameter. Sunk from the bottom of the well are several iron pipes which bring the artesian water from the water bearing stratum about 100 feet below the bottom of the well proper and about 160 feet below the surface of the ground immediately around the well. The wall of the well is made of brick and concrete. The wall was found to be cracked in places and the staining of the wall about some of these cracks gave evidence that at times there had been seepage of surface or "ground" water into the well. There were observed a number of old pipes passing through the wall within a distance of 15 or 20 feet below the ground surface, which had been used as drains, blow-offs, etc., when the old steam pump, some of the machinery of which is still in the well, was in operation.

The writer was informed by the city water commissioner that all of these old pipes had been securely stopped up when, some years before, the pumping machinery located in a pit about 50 feet south-east of the well had been installed, and that there was no chance for anything to enter the well through any of these old pipes. On the frequent inspections of the well by the writer these pipes were closely scrutinized, but at no time was any one of them found to be discharging into the well. Furthermore, had there been at that time any considerable drainage into the well through either the old pipes or cracks in the wall it would have been evidenced in the results of the bacteriological examination of the water. A sewer passed within about 37 feet of the well and there were a number of grossly insanitary surface privies within a few hundred feet of the well, so that pollution of the ground water in the immediate vicinity of the well was certain.

The bulk of evidence pointed to the Rice well as the source of infection which had caused the typhoid outbreak, but the findings in the investigation did not justify a dogmatic conclusion that the Rice well had been the source of the infection. It was conceivable that during the period of causation of the outbreak the soil about the well lacked its usual filtering, or some other qualities, to prevent contaminating matter in the surroundings of the well from entering the well. The relation of the period of causation of the outbreak to rainfall was noted. Judging by the dates of onset of cases the period of causation of the outbreak proper began about August 1 and terminated about August 20. May, June, and July were unusually dry months. Toward the end of the long dry spell, it was said, the ground in the vicinity was generally fissured, some of the fissures being observed to extend to a depth of 4 or 5 feet below the surface. On August 2, 3, and 4 light rains occurred, but they were said not to have been sufficient to have had much apparent effect in changing the very dry condition of the soil. On August 17 there was quite a heavy rain, the first for several months, the fall amounting to 2.31 inches. Through the remainder of August and through September the rainfall was somewhat in excess of the normal. Thus the time of the first heavy

rain after the long drought about corresponded with the end of the period of causation of the typhoid outbreak.

At the A Street well the water as it came up into the well proper through the pipes from the deep water-bearing stratum was found to be free from contamination, but some of the samples of water as it was pumped from the well and reservoir showed the presence of colon bacilli. It appeared, therefore, that the contamination of the water of the A Street well was taking place in the well and not in the deep water-bearing stratum. A small stream of water was found trickling through a crack in the wall of the well about 20 feet below the ground level. Examination of the water trickling through the leak showed it to be highly polluted, colon bacilli being found in 0.1 cubic centimeter. Furthermore, there was some chance for contamination of the A Street well water to occur from dust and surface drainage finding their way through the poorly fitting covers to the manholes leading to the underground reservoirs into which the water from the A Street well was pumped before being distributed.

At the F Street well whatever "ground" water found its way through the wall of the well was excluded from the water obtained from the deep stratum by an inner cement basin which had been constructed so as to have a space of about 3 feet between the outer surface of the basin and the wall of the well.

CONCLUSIONS AND RECOMMENDATIONS.

Upon terminating the investigation on November 17, a verbal report was made to the city council. The meeting of the council for the purpose of receiving the report was public and was attended by a number of interested citizens. The findings of the investigation were discussed and the following conclusions and recommendations submitted:

CONCLUSIONS.

1. That a distinct outbreak of typhoid fever had occurred during August, 1911, in that section of the city bounded on the south by J Street and on the west by Fourteenth Street.

2. That insanitary conditions in respect to faulty privies and water closets, personal contact, flies and foods, probably had operated to some extent in the spread of the infection, but that the chief source of the infection immediately responsible for the outbreak was the public water supply.

3. That the infection responsible for the outbreak reached the water supply either at the Rice well or at some place or places in the water mains distributing water especially to the section north of J Street and east of Fourteenth Street.

4. That it was highly advisable to engage the services of an expert sanitary engineer with a view to having determined as exactly as possible all dangerous relations of sewers to water mains and wells.

5. That the water of the Rice well and the F Street well during the period of investigation was free from contamination, but that this finding did not prove that the Rice well had not been dangerously polluted during the period of causation of the outbreak and offered no assurance whatever that this well might not become dangerously contaminated at any time in the future.

6. That the water of the A Street well was found during the investigation to show evidence of pollution of such character as to suggest sewage as its source and that the water from that well should be regarded as potentially dangerous.

7. That all three of the public wells were of a grossly faulty type from a sanitary standpoint and should be reconstructed as soon as practicable, so as to have tubular water-tight casings extend from the deep-water bearing stratum to the surface.

RECOMMENDATIONS.

1. Have bacteriological examinations of the water from each of the three wells and physical examinations of the wells continued practically daily until corrections of faulty conditions in and about the wells have been made, so that if any pronounced pollution should occur it could be discovered promptly and precautions taken accordingly.

2. Engage an expert sanitary engineer to make a complete survey of the water and sewage systems.

3. Have cement basins constructed in Rice and A Street wells to receive the water coming up through the pipes from the deep water-bearing stratum and to exclude absolutely from the water supply all water which might find its way through the walls of the wells.

4. Have doors over manholes leading to the reservoir at the A Street well made tight so as to prevent contamination of the water by dust and surface washings.

5. Have all insanitary conditions, particularly in respect to faulty privies, in the vicinity of the wells corrected.

6. Have done away with, as soon as practicable, the obviously needless superstructures over and around the wells and have any additional wells in contemplation constructed in accordance with well-recognized modern sanitary principles for artesian wells.

None of these recommendations was carried out.

A SECOND OUTBREAK OF TYPHOID FEVER WHICH OCCURRED DURING THE WINTER OF 1911-12.

In December an extensive outbreak of enteritis ("winter cholera") occurred. The outbreak was largely confined to the section of the city north of J Street and east of Fourteenth Street. Several thousand cases are said to have developed. Suspicion fell on the Rice well, and on inspection Dr. Waite found a stream of water running into the well through an old pipe which passed through the wall about 15 feet below the road level. Dr. Waite found, on examining the water which entered through the pipe, a bacterial content much resembling that of diluted sewage.

Following the outbreak of "winter cholera" there was in the same section of the city an outbreak of typhoid fever.

Cases of typhoid were reported by months as follows:

	Cases.
December, 1911.....	4
January, 1912.....	272
February, 1912.....	28

The Rice well was closed on December 20. Treatment of the A Street well water with hypochlorite of lime was begun on January 17.

On excavating around the Rice well a near-by sewer was found to be in leaky condition, and the evidence is said to have been strong that the entrance into the Rice well of sewage from this sewer was responsible for the winter outbreak.¹

In view of these developments it seems highly probable that the summer outbreak resulted from a combination of circumstances somewhat similar to those responsible for the winter outbreak.

¹ Westerfield, William: Municipal Journal and Engineer, Feb. 22, 1912, Vol. XXXII, No. 8, p. 280.